

Quantitative Ultrasound for Liver Steatosis Assessment: Benefits of Measurements Over a Large Two-dimensional Region of Interest on the Performance of Image-brightness-based Parameters



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Introduction

- Ultrasound (US) is the **first line non-invasive** modality to screen for significant **steatosis** [1], using qualitative assessment of liver **US brightness**.
- US propagation properties of tissues **correlate with fat** content [2].
- We use **quantitative** brightness-derived parameters, **US attenuation** (UA) and **backscatter coefficient** (BSC).
- Fibroscan® Controlled Attenuation Parameter (CAP™) captures a **1D**-single beam US signal to estimate UA. Independent measurements are **accumulated over time**.

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Results

		Small ROI	Medium ROI	Large ROI
Inter-operator Reproducibility	ICC _{UA} [CI 95%]	0.72 [0.56-0.83]	0.81 [0.68-0.89]	0.92 [0.85-0.96]
	ICC _{BSC} [CI 95%]	0.80 [0.69-0.88]	0.84 [0.73-0.91]	0.93 [0.88-0.97]
Intra-operator Reproducibility (experts)	ICC _{UA} [CI 95%]	0.77 [0.61-0.87]	0.82 [0.69-0.90]	0.93 [0.86-0.97]
	ICC _{BSC} [CI 95%]	0.83 [0.71-0.90]	0.89 [0.79-0.94]	0.94 [0.88-0.97]
Intra-operator Reproducibility (novices)	ICC _{UA} [CI 95%]	0.79 [0.64-0.88]	0.89 [0.78-0.94]	0.91 [0.77-0.96]
	ICC _{BSC} [CI 95%]	0.86 [0.76-0.93]	0.91 [0.83-0.96]	0.93 [0.84-0.97]
Correlation with new CAP (r ²)	r ² _{UA}	0.48	0.51	0.6
	r ² _{BSC}	0.57	0.59	0.64
Failure rate		8% (5 patients)	10% (6 patients)	22% (13 patients)

Good (0.7≤ICC<0.8)

Very good (0.8≤ICC<0.9)

Excellent (0.9≤ICC)

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Aim

1. Assess performances of brightness-derived parameters on ultraportable point-of-care device Hepatoscope™, using a **2D region of interest** (ROI).
1. Assess the **impact of the ROI size** over the **robustness** of UA and BSC measurements.

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Method

- Single center study with 60 patients (NCT04782050).
- Fibroscan® CAP™ + 4 Hepatoscope liver-exams.
- 2 operators: 1 novice and 1 expert, blinded to values.
- 10 consecutive sets of US raw data were collected each time.
- UA and BSC computed on 3 different ROI sizes.
- Assessment of intra- and inter-operator reproducibility (ICC with 95% CI).
- Correlations vs. Fibroscan® CAP™.

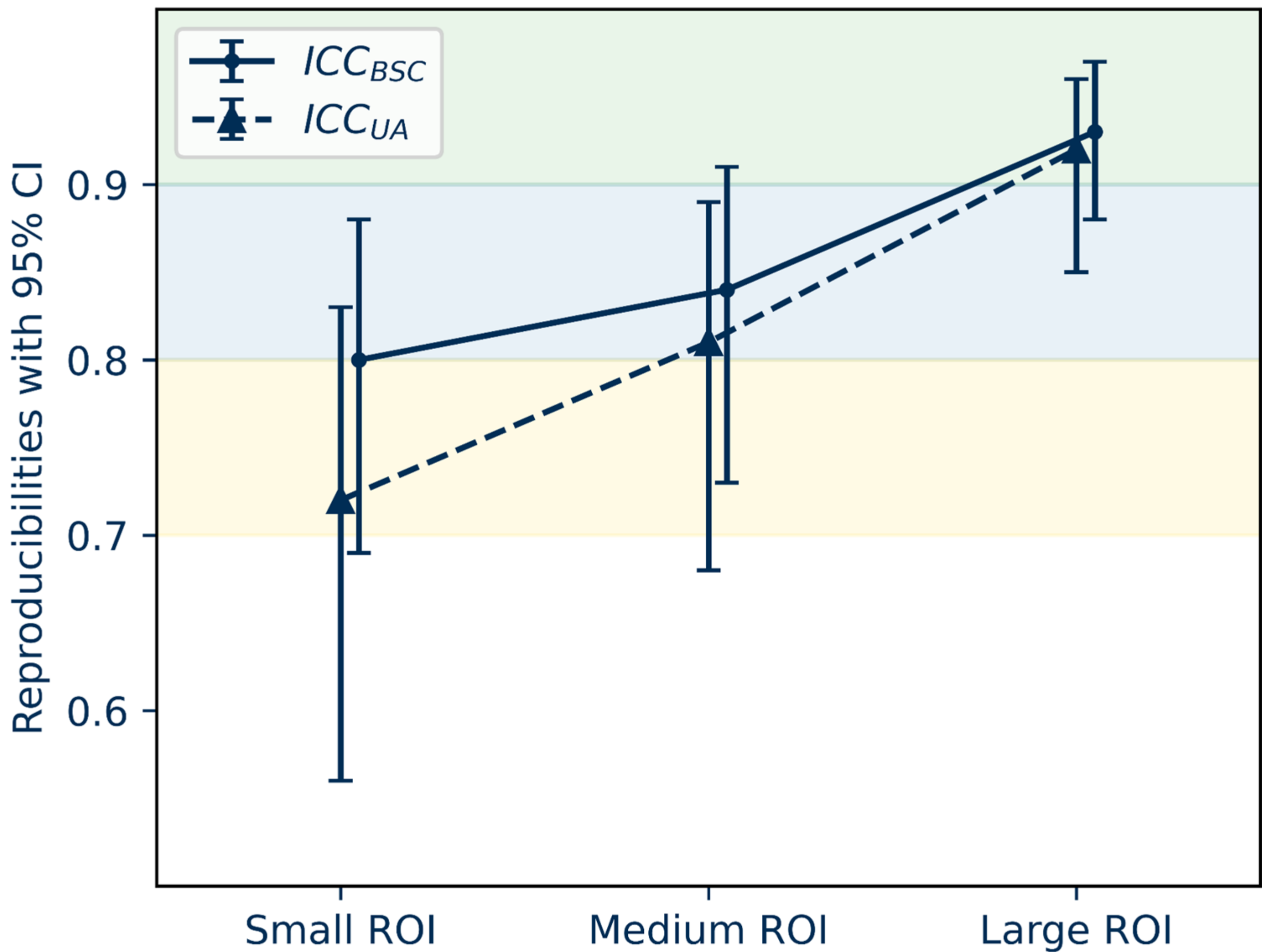


Figure 1: Evolution of inter-operator reproducibilities of BSC and UA with the size of the ROI.

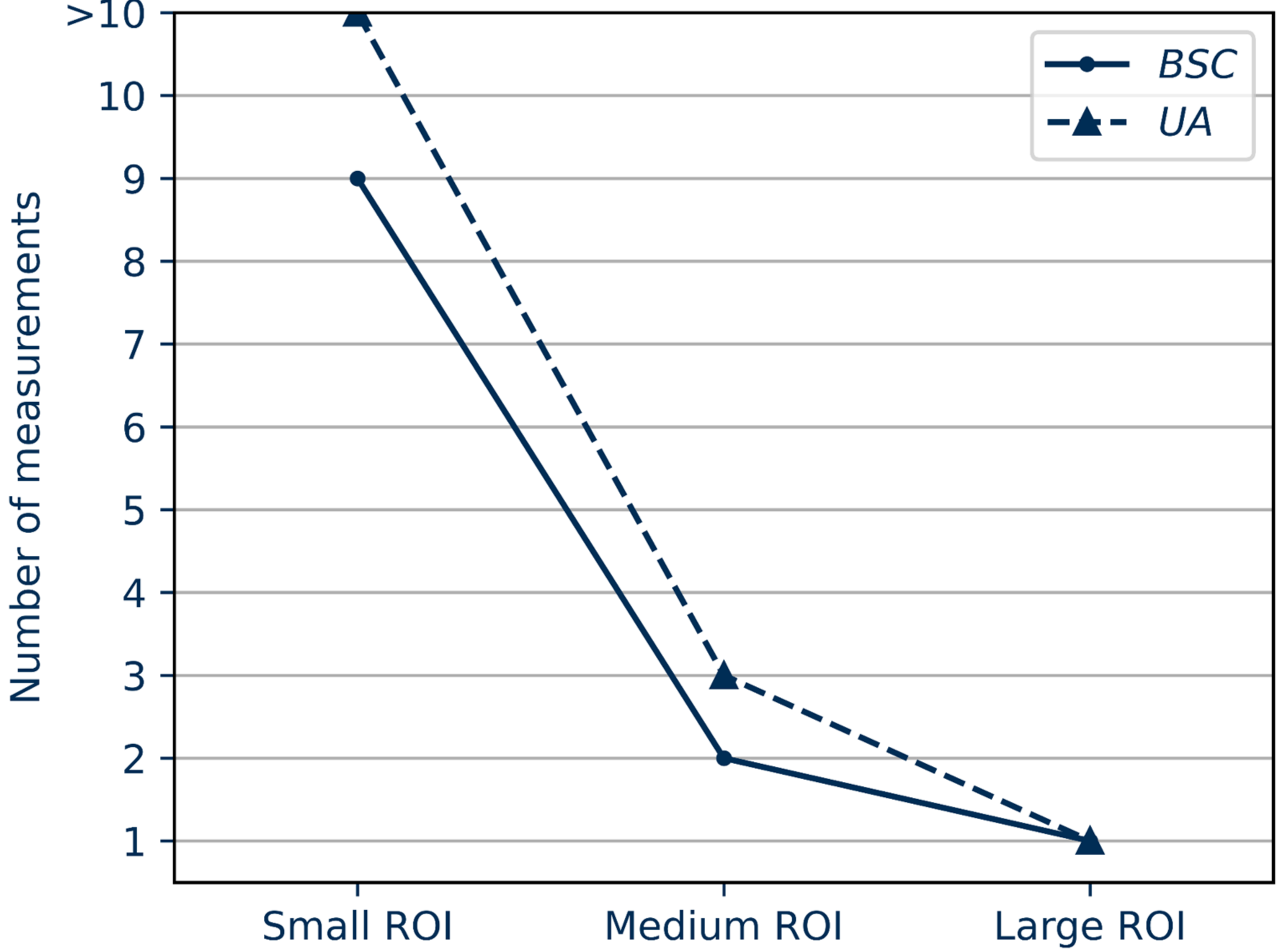


Figure 2: Number of measurements needed to obtain very good inter-operator reproducibilities of BSC and UA.

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Conclusions

- UA and BSC measurements can be performed with Hepatoscope™ with very good reproducibility and repeatability.
- The **larger the ROI**, the more robust the measurements.
 - A **single value** over a large ROI is enough to estimate UA and BSC reliably, paving the way to **low exam times** for liver steatosis assessment.

Future comparative studies with MRI-PDFF and histological scores will allow better assessment of this method to estimate UA and BSC for steatosis staging.

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References

- 1 **EASL; EASD; EASO**. EASL-EASD-EASO Clinical Practice Guidelines for the management of non-alcoholic fatty liver disease. J Hepatol. 2016 Jun;64(6):1388-402.
- 2 **Han A et al**. Assessment of Hepatic Steatosis in Nonalcoholic Fatty Liver Disease by Using Quantitative US, *Radiology* 2020 295:1, 106-113

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Brightness-Based Quantitative Ultrasound:
The Larger The Region of Interest,
The More Robust The Measurements

